US009319769B2

(12) **United States Patent**
Burgett et al.

(10) **Patent No.: US 9,319,769 B2**
(45) **Date of Patent: Apr. 19, 2016**

(54) **WIRELESS HEADPHONES**

(71) Applicant: **Harman International Industries, Incorporated**, Stamford, CT (US)

(72) Inventors: **Seth D. Burgett**, Glen Carbon, IL (US); **Effrosini A. Karayiannis**, St. Louis, MO (US); **Aaron Gorga**, St. Louis, MO (US)

(73) Assignee: **Harman International Industries, Incorporated**, Stamford, CT (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 31 days.

(21) Appl. No.: **14/253,681**

(22) Filed: **Apr. 15, 2014**

(65) **Prior Publication Data**

US 2014/0307891 A1 Oct. 16, 2014

Related U.S. Application Data

(60) Provisional application No. 61/812,229, filed on Apr. 15, 2013.

(51) **Int. Cl.**
H04R 1/10 (2006.01)
H04R 5/033 (2006.01)

(52) **U.S. Cl.**
CPC ***H04R 1/105*** (2013.01); *H04R 1/1016* (2013.01); *H04R 5/0335* (2013.01); *H04R 2420/07* (2013.01)

(58) **Field of Classification Search**
CPC H04R 5/033; H04R 5/04; H04R 1/1041; H04R 1/1016; H04R 2420/07
USPC 381/74
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,845,751	A *	7/1989	Schwab	H04H 20/88 381/105
5,095,382	A *	3/1992	Abe	H04B 10/114 320/107
5,349,386	A *	9/1994	Borchardt	H04B 1/0096 348/485
2004/0037444	A1 *	2/2004	Redmer	H04R 1/1058 381/370
2004/0134710	A1 *	7/2004	Yang	H04R 1/1066 181/129
2005/0185814	A1 *	8/2005	Chen	H04R 1/1066 381/381
2007/0258613	A1 *	11/2007	Wright	H04R 1/105 381/374
2008/0080704	A1 *	4/2008	te Riet	H04R 1/1066 379/430
2008/0187164	A1 *	8/2008	Chou	H04R 1/1033 381/381
2008/0310666	A1 *	12/2008	Wengreen	H04R 1/026 381/381

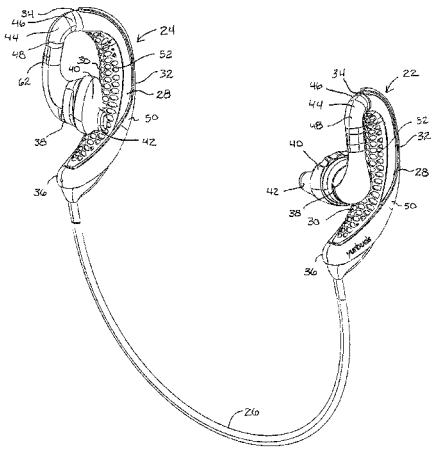
(Continued)

Primary Examiner — Simon Sing
(74) *Attorney, Agent, or Firm* — Brooks Kushman P.C.

(57) **ABSTRACT**

Wireless headphones include left and right earphones connected by a cable. Each of the left and right earphones comprising a generally C-shaped body adapted to fit behind the user's ear, with a concave inner edge, a convex outer edge, a first end that is positioned generally adjacent the top of the user's ear and a second end positioned generally adjacent the bottom of the user's ear when the body is positioned behind the user's ear. A speaker having a sound tunnel associated therewith adapted to fit in the ear canal of the wearer; a resilient support extending forwardly and downwardly from the top end of the C-shaped body, the support normally supporting the speaker in a position which, when the C-shaped body behind the user's ear, is misaligned with the user's ear canal, but resiliently deflects to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the C-shaped body against the user's head.

20 Claims, 9 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2009/0022352 A1* 1/2009 Weibel H04R 1/1066 381/378
2009/0135017 A1* 5/2009 Lee H04R 1/1025 340/636.1
2011/0170703 A1* 7/2011 Palma H04R 1/1041 381/74
2012/0070028 A1* 3/2012 Margulies H04R 1/105 381/380

* cited by examiner

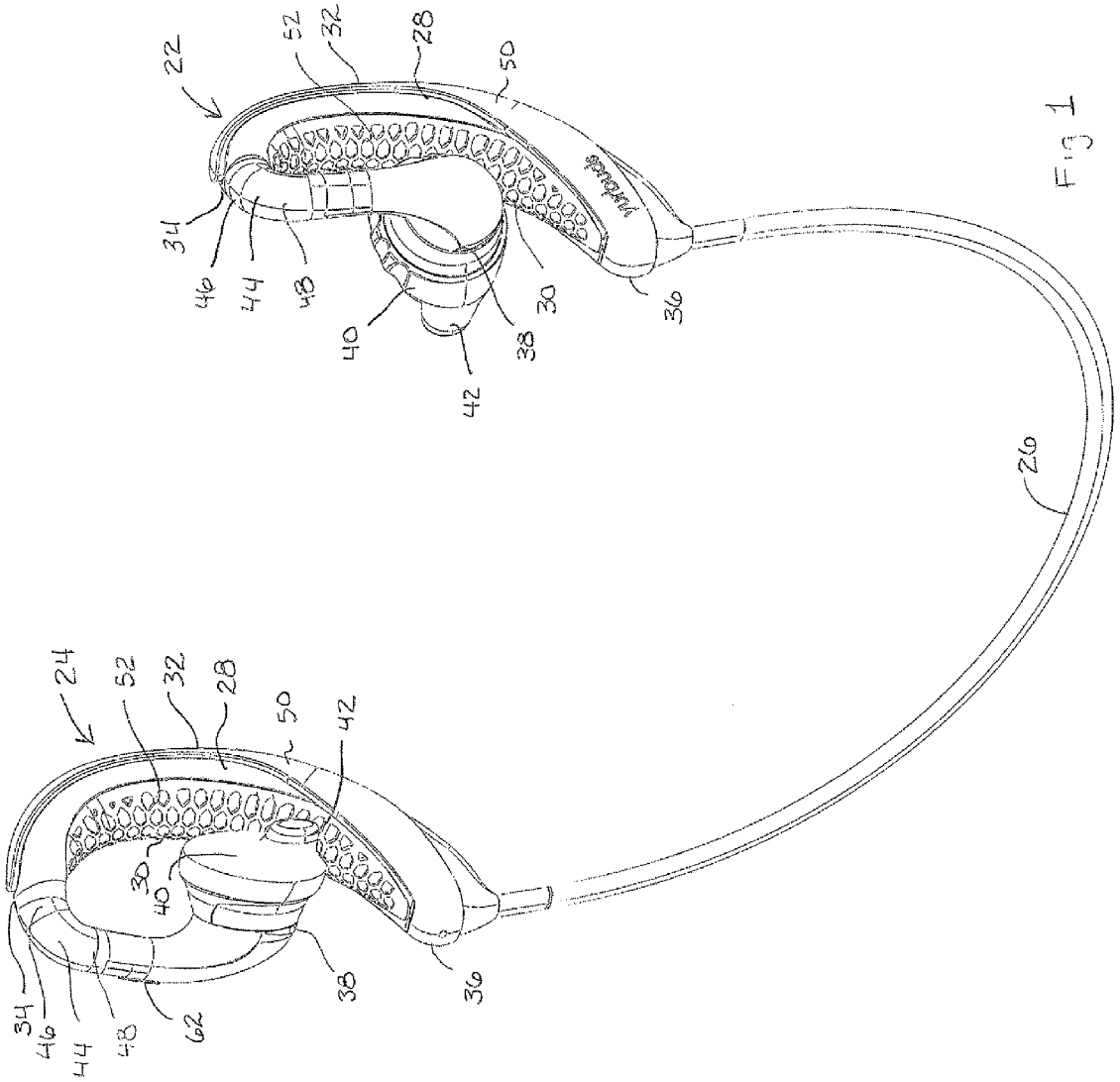


Fig 1

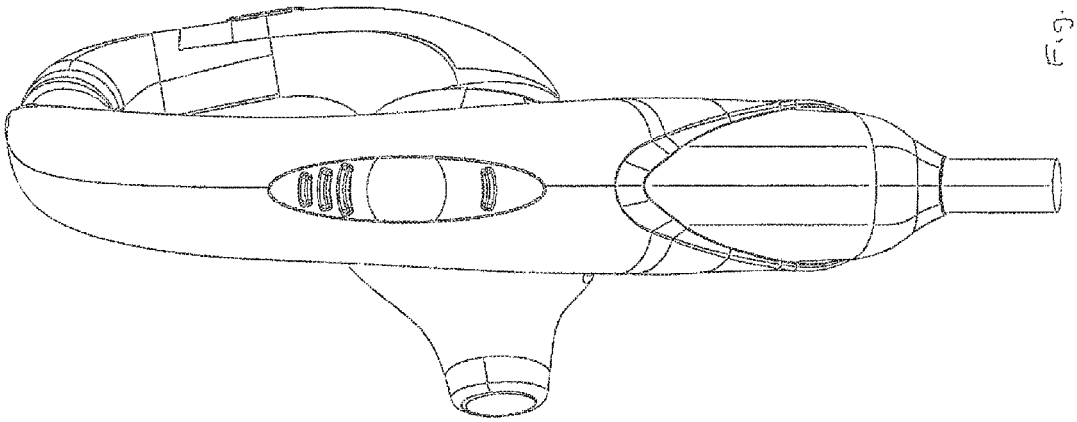


Fig. 3

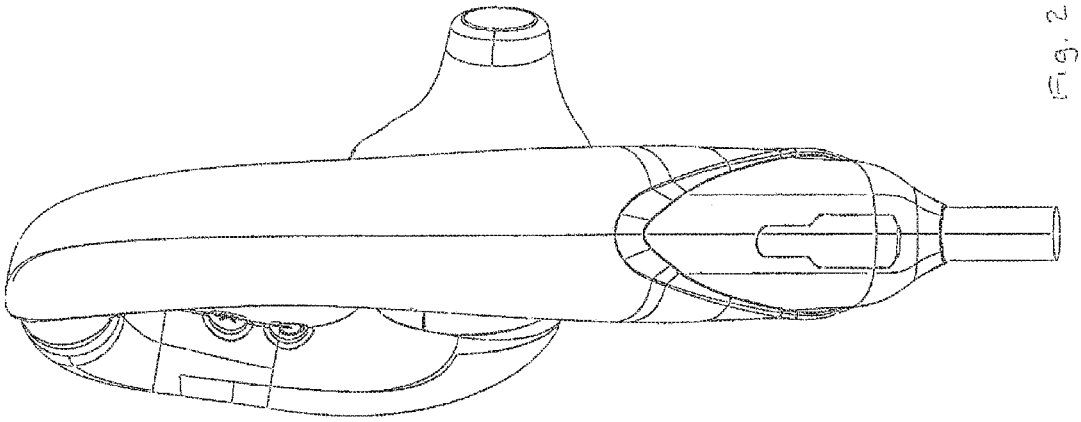


Fig. 2

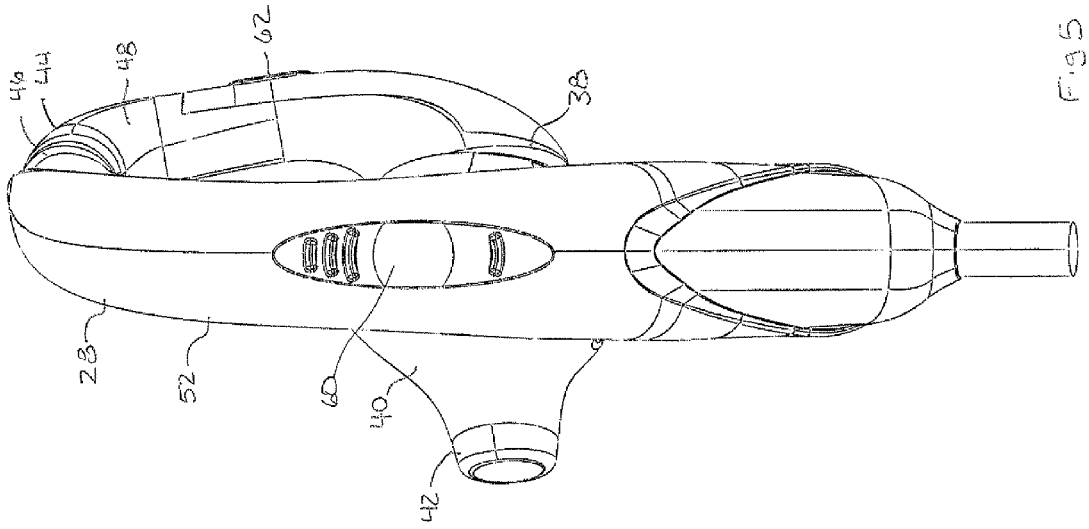


Fig. 5

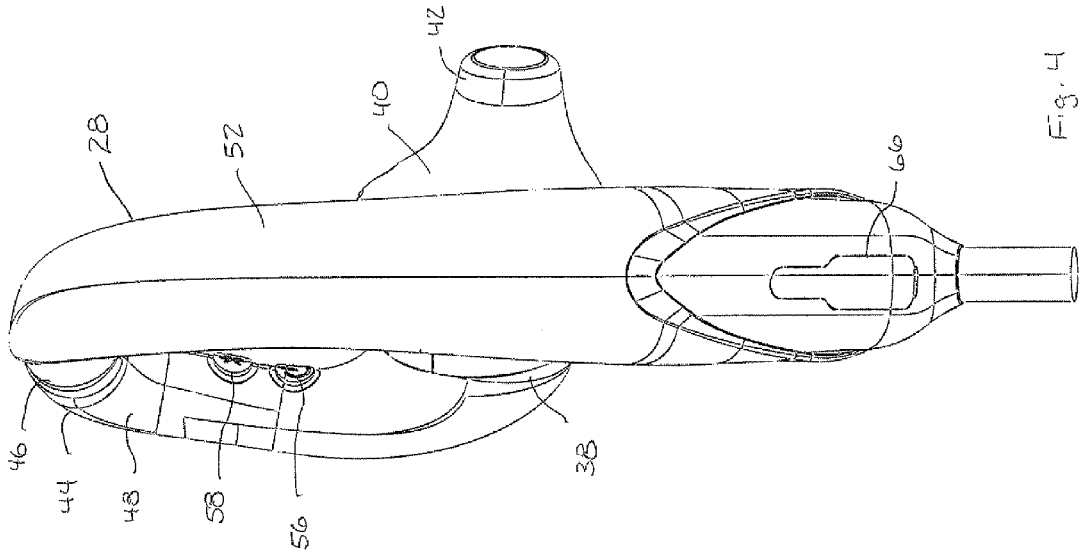


Fig. 4

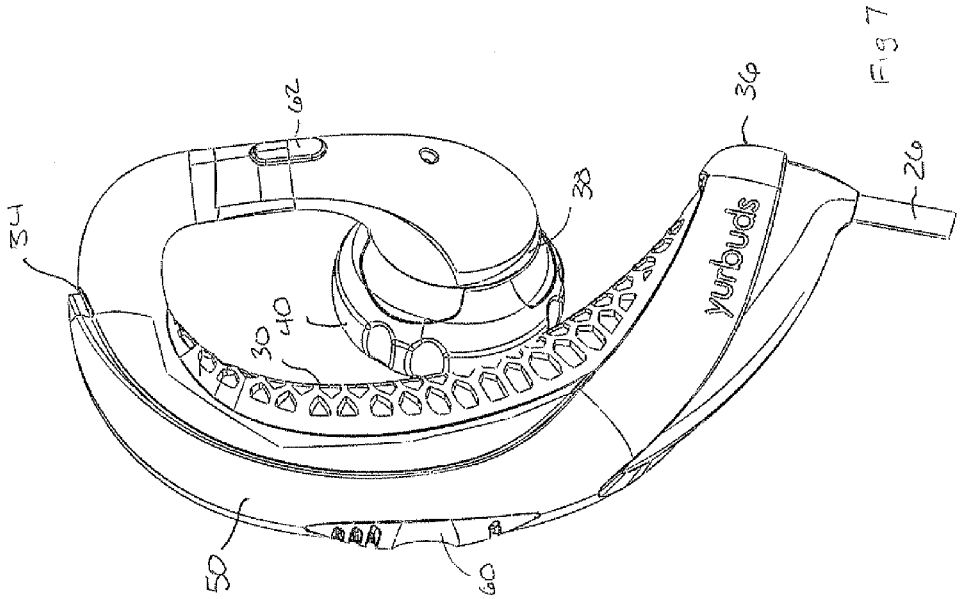


Fig 7

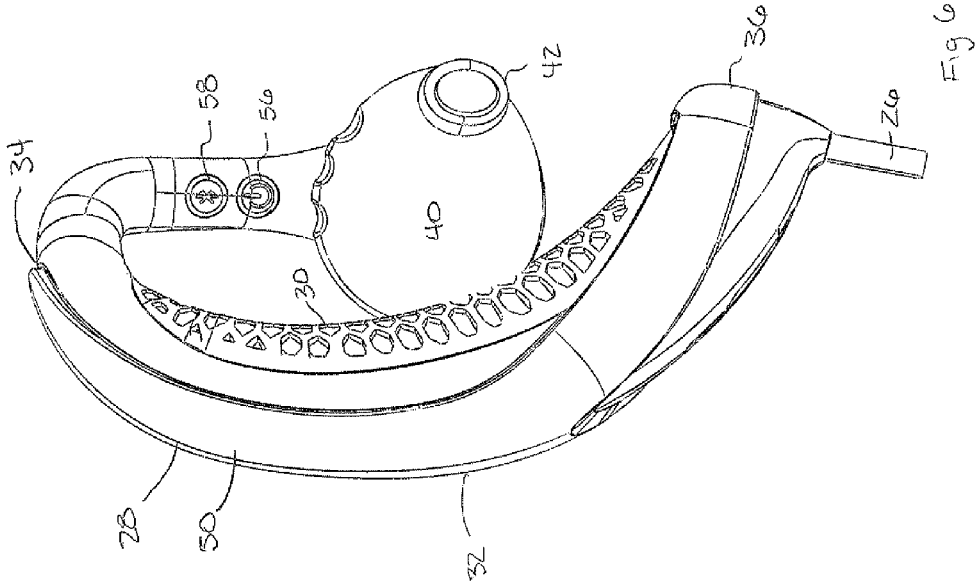


Fig 6

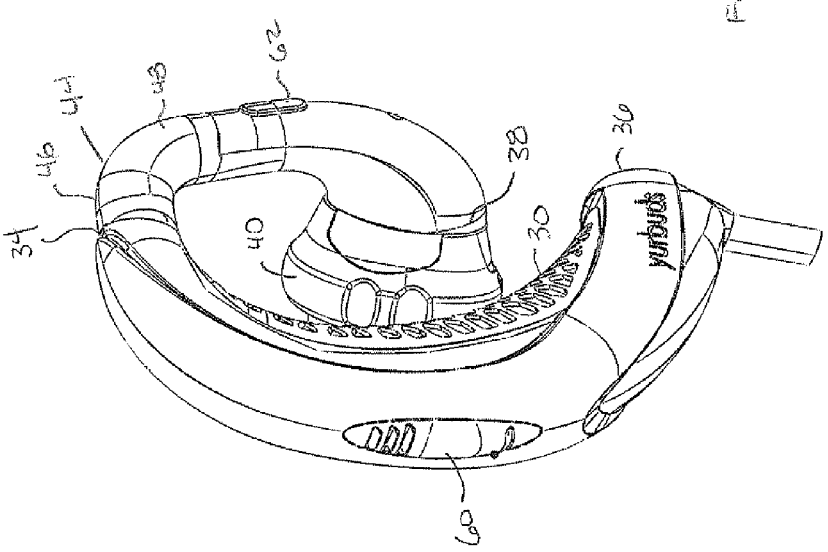


Fig. 9

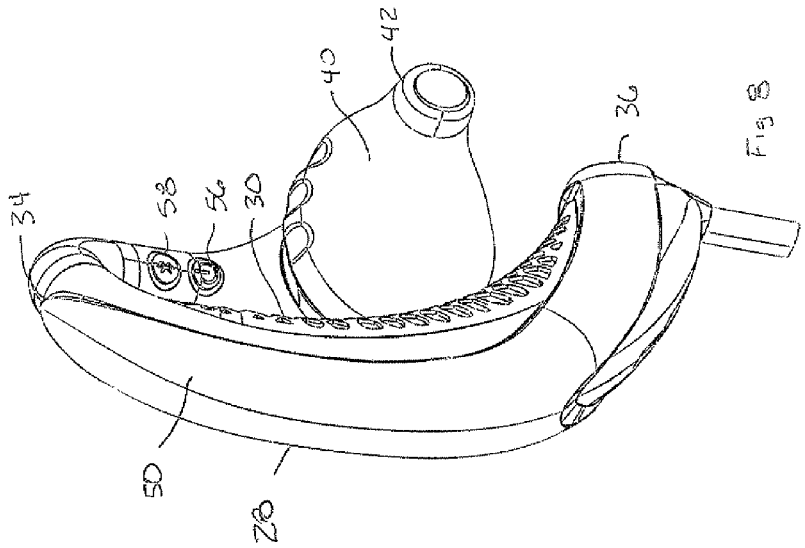


Fig. 8

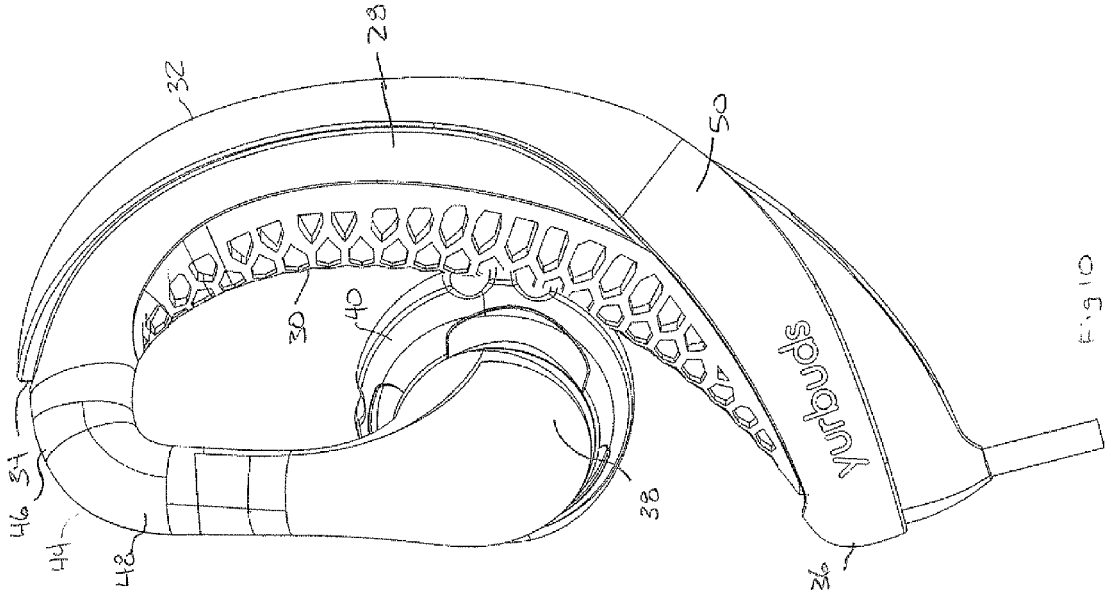

28
32
50
30
40
38
yurbuds
46
34
44
48
36

Fig 10

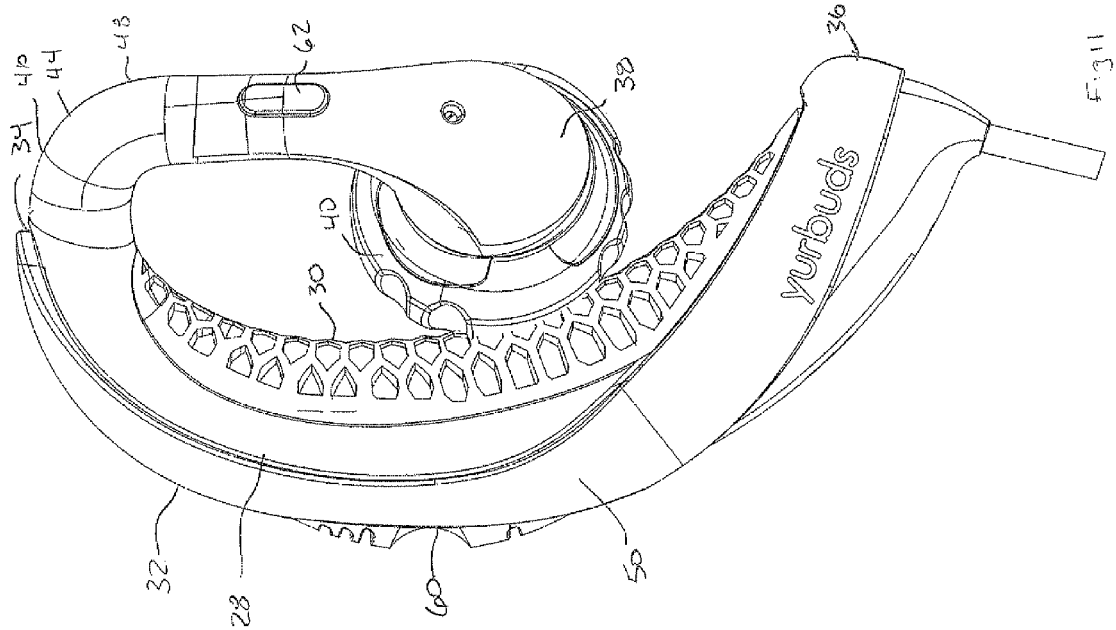

43
62
34
40
44
38
36
40
30
yurbuds
32
28
60
50

Fig 11

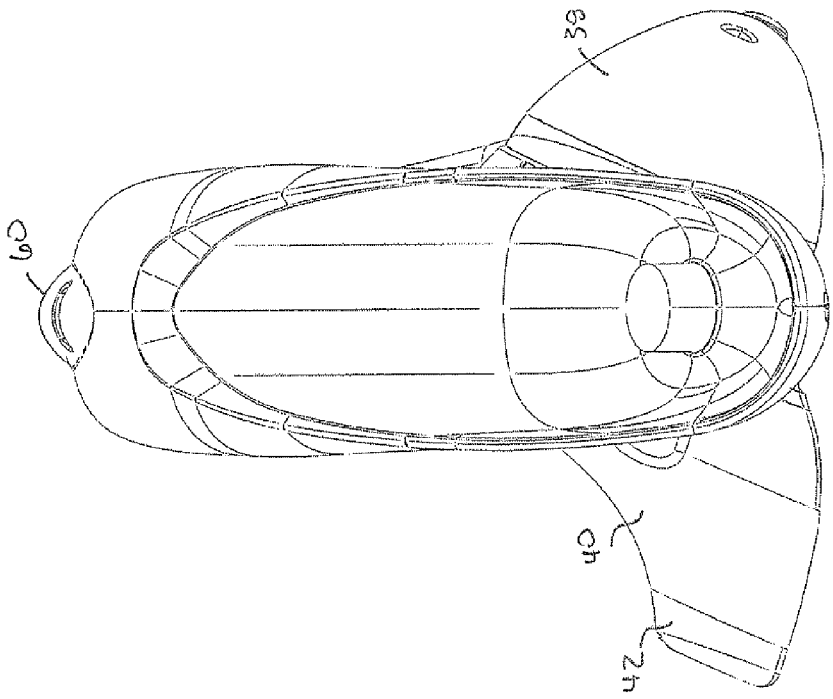


Fig 13

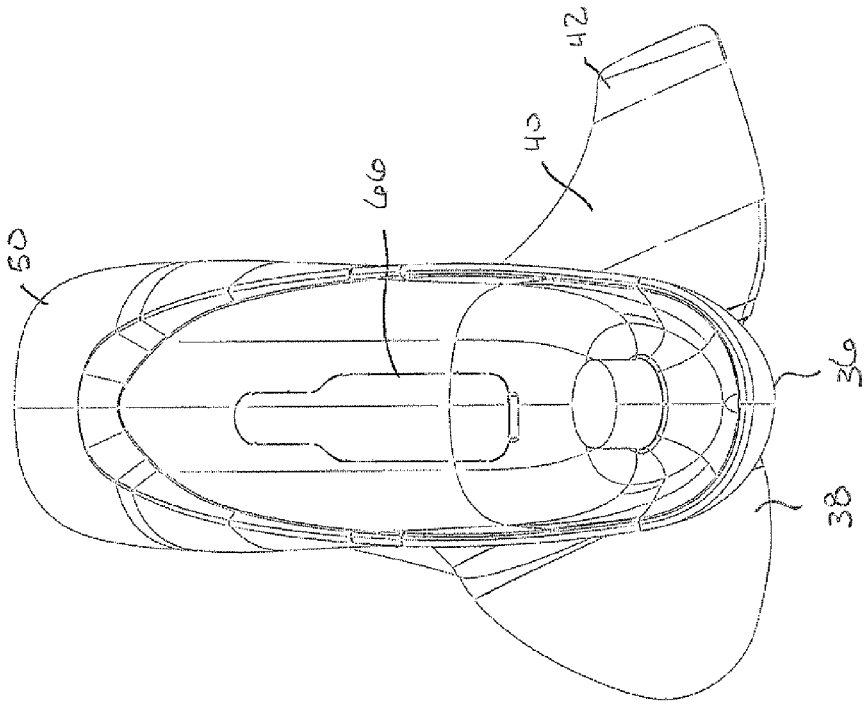


Fig. 12

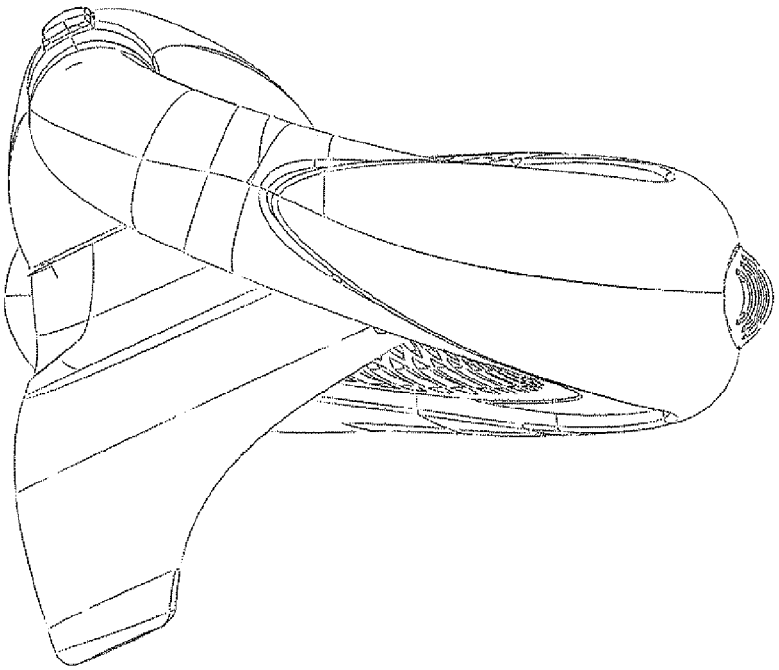


Fig 15

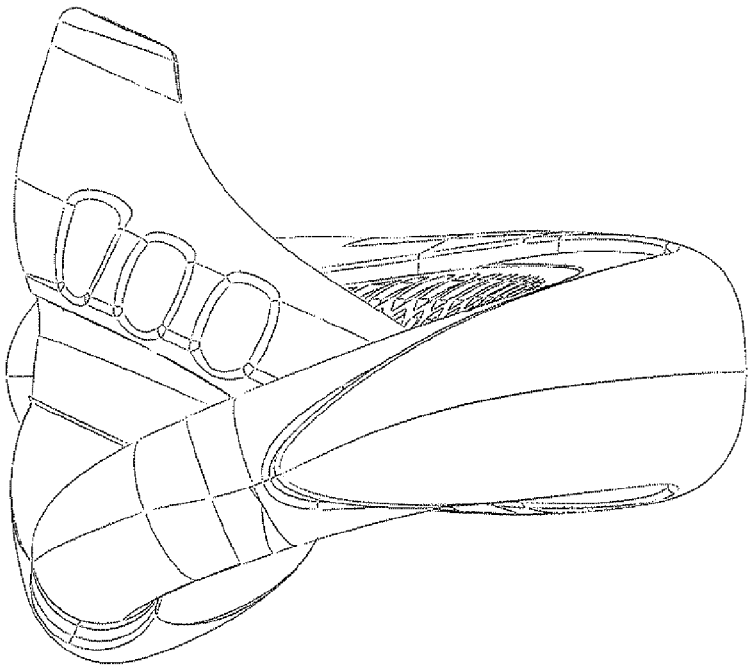


Fig 14

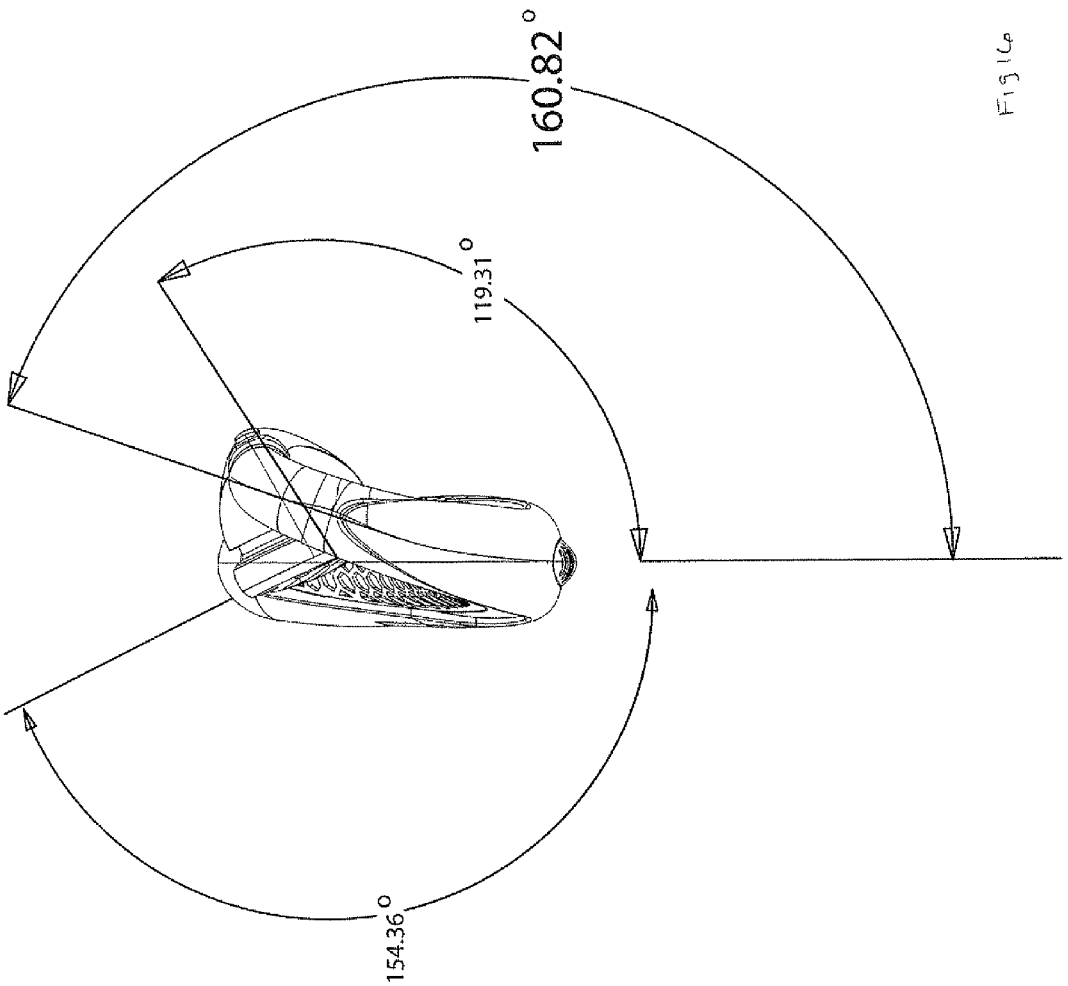


Fig 16

WIRELESS HEADPHONES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application Ser. No. 61/812,229, filed Apr. 15, 2013. The entire disclosure of the above-referenced application is incorporated herein.

FIELD

The present disclosure relates to wireless headphones, and in particular to wireless headphones that securely but comfortably engage the user's ears.

BACKGROUND

This section provides background information related to the present disclosure which is not necessarily prior art.

Wireless headphones provide a convenient way for a user to listen to music without a wired connection to a music player or telephone. However because wireless headphones must include an independent power supply and wireless communication device, these headphones are usually heavier than conventional earbuds. This extra weight can make wireless headphone more susceptible to becoming displaced, particularly when used during vigorous activities.

SUMMARY

This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

Embodiments of this invention provide wireless headphones that securely, but comfortably engage the user's ears, so that the headphones remain in place, even during vigorous activity.

A preferred embodiment of a wireless headphone comprises left and right earphones connected by a cable. Each of the left and right earphones comprising a generally C-shaped body adapted to fit behind the user's ear. This body has a concave inner edge, a convex outer edge, and a first end that is positioned generally adjacent the top of the user's ear and a second end positioned generally adjacent the bottom of the user's ear when the body is positioned behind the user's ear. Each earphone also comprises a speaker having a sound tunnel associated therewith that is adapted to fit in the ear canal of the wearer. A resilient support, extending forwardly and downwardly from the top end of the C-shaped body, which in its normal configuration supports the speaker in a position in which the sound tunnel is misaligned with the user's ear canal, but the support can resiliently deflect to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resilient engaging the earphone with the user's head.

In some embodiments, the distance between the concave inner edge of the earphone and the sound tunnel is less than the distance between back of the user's ear and the ear canal. In these embodiments the support resilient deflects by bending to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resilient biasing the concave inner edge of the C-shaped body against the back of the user's ear.

In some embodiments, the angle of the sound tunnel is misaligned with the angle of the user's ear canal. In these embodiments the support resiliently deflects by twisting to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the C-shaped body against the side of the user's head.

In the preferred embodiment, the distance between the concave inner edge of the earphone and the sound tunnel is less than the distance between back of the user's ear and the ear canal and the angular orientation of the sound tunnel is misaligned with the angle of the user's ear canal. In these embodiments the support resilient deflects by bending to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the concave inner edge of the C-shaped body against the back of the user's ear, and the support resiliently deflects by twisting to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the C-shaped body against the side of the user's head.

In the preferred embodiment the support is generally L-shaped, with a first portion extending generally outwardly from the first end of the C-shaped body, and a second portion extending from the end of the first portion, generally parallel to the C-shaped body.

The C-shaped body preferably comprises a hard resilient exoskeleton forming the convex outer edge, with a compliant material with a textured surface on the concave inner edge. The C-shaped body preferably has a generally triangular or wedge-shaped transverse cross-section, being wider at the convex outer edge and narrower at the concave inner edge. The textured surface preferably comprises a network of raised, hollow polygons, such as hexagons. The C-shaped body is preferably curved in the plane of the C-shaped body, to accommodate the curve of the user's head.

The headphones can comprise a light source, for example on the support of at least one of the earphones, oriented to face the user's ear when the earphone is mounted on the user's ear. This light source can emit non-white colored light, and preferably includes an LED.

Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

FIG. **1** is a perspective view of a preferred embodiment of headphones, in accordance with the principles of this invention;

FIG. **2** is a front elevation view of the left ear earphone;

FIG. **3** is a front elevation view of the right ear earphone;

FIG. **4** is a rear elevation view of the left ear earphone;

FIG. **5** is a rear elevation view of the right ear earphone;

FIG. **6** is a perspective view (from the left rear side) of the left ear earphone;

FIG. **7** is a perspective view (from the left rear side) of the right ear earphone;

FIG. **8** is a perspective view (from the left rear side) of the left ear earphone;

FIG. **9** is a perspective view (from the left rear side) of the right ear earphone;

FIG. **10** is a perspective view (from the right front side) of the left ear earphone;

FIG. **11** is a perspective view (from the right front side) of the right ear earphone;

FIG. **12** is a bottom plan view of the left ear earphone;

FIG. **13** is a bottom plan view of the right ear earphone;

FIG. **14** is a top plan view of the left ear earphone;

FIG. **15** is a top plan view of the left ear earphone; and

FIG. **16** is a top plan view of the right ear earphone with the enhancer removed, illustrating some of the angular orientations of the preferred embodiment.

Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

Example embodiments will now be described more fully with reference to the accompanying drawings.

A preferred embodiment of a wireless headphone in accordance with the principles of this invention is indicated generally as **20** in FIG. **1**. Headphones **20** comprise left and right earphones **22** and **24** connected by a cable **26**. Each of the left and right earphones comprises a generally C-shaped body **28** adapted to fit behind the user's ear. This body **28** has a concave inner edge **30**, a convex outer edge **32**, and a first end **34** that is positioned generally adjacent the top of the user's ear and a second end positioned generally adjacent the bottom of the user's ear when the body **28** is positioned behind the user's ear.

Each earphone **22**, **24** also comprises a speaker **38** having an enhancer **40** with a sound tunnel **42** associated therewith that is adapted to fit in the ear canal of the user. A resilient support **44**, extends forwardly and downwardly from the first end **34** of the C-shaped body **28**. The resilient support **44**, in its normal configuration, supports the speaker **38** in a position in which the sound tunnel **42** is not aligned with the user's ear canal, but the resilient support **44** can resiliently deflect to allow the sound tunnel **32** to align with and be inserted into the user's ear canal, thereby resilient engaging the earphone with the user's head.

In some embodiments, the distance between the concave inner edge **30** of the earphone **22**, **24** and the sound tunnel **42** is less than the distance between back of the user's ear and the user's ear canal. In these embodiments the resilient support **44** resiliently deflects by bending to allow the sound tunnel **42** to align with and be inserted into the user's ear canal, thereby resilient biasing the concave inner edge **30** of the C-shaped body **28** against the back of the user's ear.

In some embodiments, the angular orientation of the sound tunnel **42** is misaligned with the angle of the user's ear canal. In these embodiments the resilient support **44** resiliently deflects by twisting to allow the sound tunnel **44** to align with and be inserted into the user's ear canal, thereby resiliently biasing the C-shaped body **28** against the side of the user's head.

In this preferred embodiment, the distance between the concave inner edge **30** of the earphone **28** and the sound tunnel **42** is less than the distance between back of the user's ear and the ear canal, and the angular orientation of the sound tunnel **42** is misaligned with the angle of the user's ear canal. In this preferred embodiment the resilient support **44** resiliently deflects by bending to allow the sound tunnel **42** to align with and be inserted into the user's ear canal, thereby resiliently biasing the concave inner edge **30** of the C-shaped body **28** against the back of the user's ear, and the resilient support **44** resiliently deflects by twisting to allow the sound tunnel **42** to align with and be inserted into the user's ear canal, thereby resiliently biasing the C-shaped body **28** against the side of the user's head.

In the preferred embodiment the resilient support **44** is generally L-shaped, with a first portion **46** extending generally outwardly from the first end **34** of the C-shaped body **28**, and a second portion **48** extending from the end of the first portion, generally parallel to the C-shaped body.

The C-shaped body **28** preferably comprises a hard resilient exoskeleton **50** forming the convex outer edge **32**, with a compliant material with a textured surface **52** on the concave inner edge **30**. The C-shaped body **28** preferably has a generally triangular or wedge-shaped transverse cross-section, being wider at the convex outer edge **32** and narrower at the concave inner edge **30**. The textured surface **24** preferably comprises a network of raised, hollow polygons, such as hexagons. As best shown in FIGS. **4** and **5**, the C-shaped body **28** is preferably twists along its longitudinal axis to form a curve in the plane of the C-shaped body to accommodate the curve of the user's head. As shown in FIGS. **4** and **5**, the C-shaped body **28** of the left earphone **22** twists outwardly from the second end **36** to the first end **34**.

The headphones **20** can comprise a light source, for example on the support of at least one of the earphones, oriented to face the user's ear when the earphone is mounted on the user's ear. This light source can emit non-white colored light, and preferably includes an LED. As shown in the Figures there are two lighted buttons **56** and **58**. The button **56** is a power button, which can be used to turn on the headphones. The button **56** can include a light source, such as an LED, that illuminates when the button **56** is pressed, and/or when the power is on. The light source can be any color, but in this preferred embodiment is green. The button **58** is a blue tooth button, which can be used to connect the headphones **20** to a signal source, such as an mp3 player or phone. The button **58** can include a light source, such as an LED, that illuminates when the button **58** is pressed, and/or when a blue tooth connection is active. This light source is preferably blue.

Because of the unique positioning of the buttons **56** and **58** in opposition to the user's ear, the lights associated with the buttons can light up the user's ear, producing a unique effect. Additional lighted controls, indicator lights, or decorative lights can be provided on the earphones **22**, **24**. For example, additional light sources can be provided on the resilient support to shine on the user's ear to provide decorative lighting effect. These light sources can be LEDs that provide bright light with low power consumption. In particular, an R-G-B diodes can be used that can produce a variety of different colored light. While these lights can be purely decorative, and preferably in a color or colors selected by the user. Alternatively these lights can be indicators, for example turning on, blinking, or changing color based on a number of factors, for example, the type, volume, or rhythm of the music being played; physiologic measurements of the user, for example heart rate, which can be measured by sensors on the headphones, or on another device communicating with the headphones, or distance traveled of speed of travel, which can be measured sensors on the headphones, or another device, such as a gps enabled wristwatch or phone, communicating with the headphones.

The headphones **20** preferably include a switch **60** for controlling sound signal played by the headphones. The switch **60** preferably provides three controls, for example increase volume by pressing the upper portion of the switch, decrease volume by pressing the lower portion of the switch, and change song or change source by pressing the center portion of the switch.

Other controls can be provided on the headphones **20**, for example a switch **62**.

A power connection (not shown) can be provided to allow the headphones **20** to be recharged. A cover **66** can be provided to protect the contacts of the power connection when not in use.

As shown in FIG. **16**, the C-shaped body **28** twists along its longitudinal axis. The twist is preferably between about 10 and 30 degrees, more preferably between about 15 and 25 degrees, and in this preferred embodiment about 20 degrees. The face of the speaker **28** is preferably oriented about 26 degrees out of the plane of earphone **22**, **24**, this allows the sound tunnel to be slightly misaligned with the ear canal so that the resilient support **44** must be twisted slightly to properly position the sound tunnel, this twisting applies a resilient bias of the C-shaped support **28** against the side of the user's head.

The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

What is claimed is:

1. A wireless headphone comprising

left and right earphones connected by a cable, each of the left and right earphones comprising a generally C-shaped body adapted to fit behind a user's ear, the body having a concave inner edge, a convex outer edge, a first end that is positioned generally adjacent a top of the user's ear and a second end positioned generally adjacent a bottom of the user's ear when the body is positioned behind the user's ear;

a resilient support extending forwardly and downwardly from the first end of the C-shaped body; and

a speaker supported by the resilient support and having a sound tunnel associated therewith adapted to fit in an ear canal of the user;

wherein the support in a normal configuration supports the speaker in a position in which the sound tunnel is not aligned, with the user's ear canal, wherein the support resiliently deflects to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently engaging the C-shaped body against the user's head.

2. The wireless headphone according to claim **1**, wherein a distance between the concave inner edge of the earphone and the sound tunnel is less than a distance between a back of the user's ear and the user's ear canal, and wherein the support resiliently deflects to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the concave inner edge of the C-shaped body against the back of the user's ear.

3. The wireless headphone according to claim **1**, wherein an angle of the sound tunnel is misaligned with an angle of the user's ear canal, and wherein the support resiliently deflects by twisting to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the C-shaped body against a side of the user's head.

4. The wireless headphone according to claim **1**, wherein a distance between the concave inner edge of the earphone and the sound tunnel is less than a distance between the back of the user's ear and the ear canal and wherein an angular orientation of the sound tunnel is misaligned with an angle of the user's ear canal, and wherein the support resiliently deflects to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the concave inner edge of the C-shaped body against a back of the user's ear, and the support resiliently deflects by twisting to allow the sound tunnel to align with and be inserted into the user's ear canal, thereby resiliently biasing the C-shaped body against a side of the user's head.

5. The wireless headphone according to claim **1**, wherein the support is generally L-shaped, with a first portion extending generally outwardly from the first end of the C-shaped body, and a second portion extending from an end of the first portion, generally parallel to the C-shaped body.

6. The wireless headphone according to claim **1**, wherein the C-shaped body comprises a hard resilient exoskeleton forming the concave outer edge.

7. The wireless headphone according to claim **1**, wherein the C-shaped body comprises a compliant material with a textured surface on the concave inner edge.

8. The wireless headphone according to claim **7**, wherein the textured surface comprise a raised network of hollow polygons.

9. The wireless headphone according to claim **1**, wherein the C-shaped body twists along its longitudinal axis to form a curve in the plane of the C-shaped body, to accommodate a curve of the user's head.

10. The wireless headphones according to claim **1**, further comprising a light source on the inner concave surface of at least one of the earphones, oriented to face the user's ear when the earphone is mounted on the user's ear.

11. The wireless headphones according to claim **10**, wherein the light source emits non-white colored light.

12. The wireless headphones according to claim **10**, wherein the light source includes an LED.

13. The wireless headphone according to claim **1**, wherein the C-shaped body has a generally triangular cross-section, being wider at the convex outer edge than at the concave inner edge.

14. A wireless headphone comprising

left and right earphones connected by a cable, each of the left and right earphones comprising a generally C-shaped body adapted to fit behind a user's ear, the body having a concave inner edge, a convex outer edge, a first end that is positioned generally adjacent a top of the user's ear and a second end positioned generally adjacent a bottom of the user's ear when the body is positioned behind the user's ear;

a resilient support extending forwardly and downwardly from the first end of the C-shaped body;

a speaker coupled to the resilient support and having a sound tunnel associated therewith adapted to fit in an ear canal of the user; and

a light source on the inner concave surface of at least one of the earphones, oriented to face the user's ear when the earphone is mounted on the user's ear.

15. The wireless headphone according to claim **14**, wherein the C-shaped body has a generally triangular cross-section, being wider at the convex outer edge than at the concave inner edge.

16. The wireless headphone according to claim **14**, wherein the support is generally L-shaped, with a first portion extending generally outwardly from the first end of the C-shaped body, and a second portion extending from an end of the first portion, generally parallel to the C-shaped body.

17. A wireless headphone comprising

left and right earphones connected by a cable, each of the left and right earphones comprising a generally C-shaped body adapted to fit behind a user's ear, the body having a concave inner edge, a convex outer edge, a first end that is positioned generally adjacent a top of the user's ear and a second end positioned generally

adjacent a bottom of the user's ear when the body is positioned behind the user's ear, wherein the C-shaped body has a generally triangular cross-section, being wider at the convex outer edge than at the concave inner edge;

a resilient support extending forwardly and downwardly from the first end of the C-shaped body; and

a speaker coupled to the resilient support and having a sound tunnel associated therewith adapted to fit in an ear canal of the user.

18. The wireless headphone according to claim **17**, wherein the C-shaped body comprises a compliant material with a textured surface on the concave inner edge.

19. The wireless headphone according to claim **18**, wherein the textured surface comprise a raised network of hollow polygons.

20. The wireless headphone according to claim **17**, wherein the support is generally L-shaped, with a first portion extending generally outwardly from the first end of the C-shaped body, and a second portion extending from an end of the first portion, generally parallel to the C-shaped body.

* * * * *